2001

PRELIMINARY

FACT SHEETS ON POLLUTION FROM AGRICULTURE IN OHIO

JANUARY, 1971

:TIONS:

A. Sediment
B. Agrichemicals

Not for publication

C. Farm animals
D. Vegetation leachate
E. Rain water nitrogen

F O R E W O R D

Agriculturists in Ohio are frequently asked to explain the role of farming operations in water pollution. Field technicians of the Soil Conservation Service, and others, engaged in soil and water conservation activities are asked to speak on this subject to many interested groups. Facts on this subject for popular use are not readily available.

Information on the following pages was assembled in separate sections to meet the current need for facts on different aspects of agriculture's contribution to pollution of water and agriculture's role in its abatement. This material is brief and forthright. It is not intended to be all-inclusive nor embellished in narrative form.

Dr. W. M. Edwards, Soil Scientist (Physics), ARS-SWC, Coshocton, Ohio and Assistant Professor OARDC; Dr. Berlie L. Schmidt, Professor, Department of Agronomy, OARDC, Wooster, Ohio; and Dr. E. Paul Taiganides, Professor, The Ohio State University contributed to these facts. The author is also Professor, OARDC.

Information is mainly from the USDA-ARS-SWC Station at Coshocton. The U. S. Soils Laboratory, ARS-SWC, Beltsville, Md. made the pesticide, nitrogen, and phosphorus analyses -- deriving concentrations in water samples and computing total transport. Data in Section D were supplied by the ARS-SWC North Central Soil Conservation Research Center, Morris, Minnesota. Laboratory BOD determinations for Section C were made on Coshocton watershed runoff samples by Dr. Richard White, Assistant Professor, The Ohio State University.

Lloyd L. Harrold
Officer-in-charge

North Appalachian Experimental Watershed
USDA Agricultural Research Service
Soil and Water Conservation Research Division
Coshocton, Ohio

in cooperation with
Ohio Agricultural Research and Development Center
Wooster, Ohio

SEDIMENT

SOIL EROSION - a source of sediment, a carrier of agrichemicals

- the greatest water pollutant from farmland

EROSION CONTROL FARMING - the greatest and most widely applied of all practices for reducing pollution of surface water

Here is an example - a severe test when 5 inches of rain fell in 12 hours, July 5, 1969---------------

Figure A-1. Erosion on plowed cornland with sloping rows = 22 tons/acre soil loss.

Figure A-2. Erosion on plowed cornland with contour rows = 3 tons/acre soil loss.

Figure A-3. Erosion on no-tillage mulch cornland with contour rows = 0.03 ton/acre soil loss

KEEP THE SOIL ON THE FARM AND MANY AGRICHEMICAL POLLUTANTS OUT OF SURFACE WATERS------------

PHOSPHORUS is very strongly adsorbed by soil colloids, and the concentration in solution in contact with soils is very low. It is transported into water bodies mainly by erosion and sediment transport.

DIELDRIN and similar persistent insecticides are also mostly attached to soil -- moving by erosion. Water solubility is low.

Conclusion -- EROSION CONTROL FARMING IS VITAL TO MINIMIZING AGRICHEMICAL POLLUTION OF WATER BODIES

AGRICHEMICALS

POLLUTION from FERTILIZER -- PHOSPHORUS and NITROGEN

PHOSPHORUS

PHOSPHORUS concentration in runoff water averaged 0.02 ppm from a mixed-crop hill land watershed in southeast Ohio and 0.015 ppm from an adjacent woodland watershed, with little variation with flow rates or season. There was little erosion from either watershed. PHOSPHORUS does not move from cropland into water bodies in significant amounts unless transported by soil particles to which it is firmly attached. Under EROSION CONTROL farming practices, little PHOSPHORUS is supplied to streams, ponds, or lakes -- even though fertilizer is generously applied to the land.

PHOSPHORUS does not normally leach through the soil to pollute ground water. Only if phosphorus-enriched soil or animal waste were allowed to pass quickly through soil cracks or large pores, could ground water quality be influenced. Even then, its strong attachment to fine soil particles would allow only very low concentrations to appear in spring and well water supplies.

NITROGEN

NITROGEN in nitrate form is very water soluble -- it moves with water over land and through the soil profile. Organic matter and nitrogen are naturally high in the topsoil of many Ohio soils (0.1 - 0.2%N, or about 2,000-4,000 lb./acre, total nitrogen in northwest Ohio soils). NITROGEN is also taken out of the air and released in water of ponds or lakes by blue-green algae and in soil by nitrogen-fixing bacteria. Runoff from natural watersheds often is nearly as high in nutrients as that from well-fertilized cropland. Data from watersheds at Coshocton show:

Wooded watershed	1 lb/acre/yr (Nitrate in runoff)
Cropped watershed	3 lbs/acre/yr (Nitrate in runoff)

NITROGEN added in fertilizers in Ohio barely balances crop removal and losses by volatilization. Use of rates of nitrogen fertilizer as recommended in the Agronomy Guide maximizes plant cover and thereby often reduces nutrient loss in runoff by reducing soil and water loss. As found at the University of Missouri:

	N applied on corn Lb/acre	NO_3-N lost Lb/acre	Runoff Cu.ft./acre
Clean tilled fallow	0	0.80	140
Rotation corn	9	.40	64
Continuous corn	9	.09	28
Continuous corn	177	.01	7

NITROGEN can be a pollution hazard where excessively high rates are used on sandy, sloping, or frozen soils. Nitrate buildup in soil profiles can occur in livestock feedlots, and runoff control measures must be developed.

Soil and water conservation practices along with use of recommended rates of nitrogen fertilizer in the Agronomy Guide can greatly reduce losses of fertilizer nutrients in sediments and runoff water.

AGRICHEMICALS--PESTICIDES

PESTICIDES - must be used today to control pests that compete with man for survival.

PESTICIDES used in agribusiness can be potential SOURCES OF POLLUTION to the ENVIRONMENT. Some pesticides are PERSISTENT. Some readily DEGRADE.

PERSISTENT insecticide (dieldrin) movement is studied on Coshocton Research Station watersheds

Figure B-1. Spraying dieldrin (oil-water emulsion mix) on corn seedbed

In corn year, 5 lb/acre dieldrin sprayed on seedbed, disced in 3 inches, and corn planted, (fig.B-1)

Losses the year of application =
- in application = 25%
- in water = 0.07%
- in air = 2.9%
- in crop = 0.03%
- in groundwater = 0% of that applied

LOSSES CAN BE REDUCED BY BETTER MANAGEMENT

Application: Movement of pesticide into the air occurs by vaporization from liquid spray application (fig. B-1). Hot, windy days are the worst -- greater pollution of the atmosphere. This movement could be reduced by subsurface placement or use of granules. Other means will be developed. Where recommended for pest control, incorporation of chemicals into the soil soon after application will also reduce their movement into the air.

Runoff losses:

DIELDRIN solubility in water is low (0.1 ppm). DIELDRIN is strongly attached to soil particles.

DIELDRIN moves into water bodies, mostly transported by sediment.

DIELDRIN transported by WATER is small. Storm runoff from a corn-field 2 weeks after dieldrin treatment contained 0.02 ppm dieldrin in the water and 14 ppm dieldrin on the suspended sediments.

Reduction of SOIL EROSION by CONSERVATION FARMING reduces DIELDRIN in surface flow. Results from the July 5, 1969 severe storm show:

1. Without conservation farming, 22 tons/acre soil eroded.

2. With conservation farming, 3 tons/acre soil eroded.

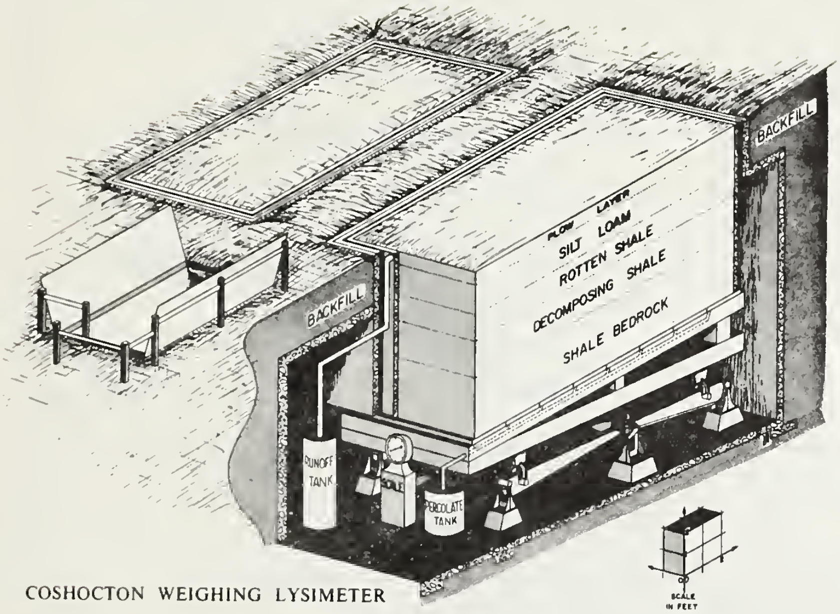
3. With no-tillage corn culture, 0.03 ton/acre soil eroded.

DIELDRIN transport would be - greatest in No. 1, 80% less in No. 2, the least in No.3 (fig. B-2) -- about 100% reduction.

Figure B-2. No-tillage corn planting in sod.

DIELDRIN did not move downward through the soil below the 3-inch depth of field mixing.

METHOXYCHLOR, another persistent insecticide, applied to the soil did not move through the natural soil of a lysimeter (fig. B-3) to underground water.



Methoxychlor, a persistent insecticide, was applied to the land surface of this soil block lysimeter. None was found in the percolating water at the 8-foot depth, as much as 14 months later.

Figure B-3. Natural soil block lysimeter to study percolation transport of pollutants through soil to underground water

FARM ANIMALS

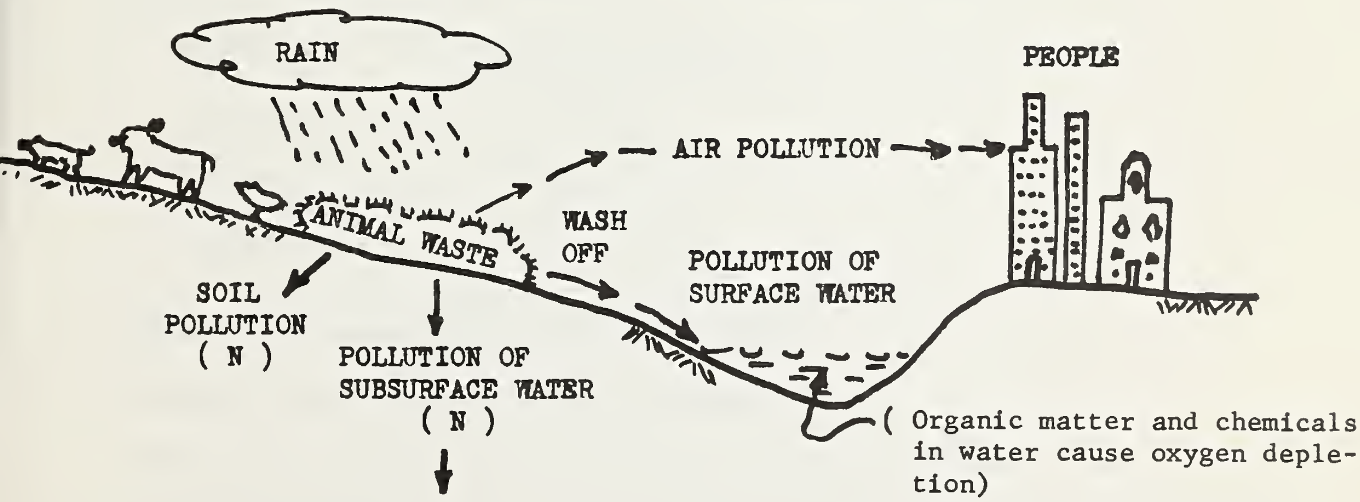
POLLUTION FROM FARM ANIMALS ---

Results mostly from concentration of animals in:

- Beef cattle feedlots
- Dairy barns and yards
- Swine barns and yards
- Sheep barns and yards
- Poultry houses

Pollution is found in:

1. AIR - Odors
   - Noxious gases
2. SOIL - Plant injury from large amounts of rich waste
   - Septic conditions of soil
3. WATER -- Large microbial decomposition of high organic content of water reduces oxygen content so that fish cannot live (expressed as chemical oxygen demand, COD, and biological oxygen demand, BOD).
   - Toxic materials (e.g. high levels of nitrate) are produced by waste decomposition.
   - Bacterial and viruses are present in water.



Streamflow from a 0.4-acre beef cattle barnlot at the Coshocton Station was seriously polluted.

Quality of streamflow was much better after passing through a 1/4 mile waterway, much of which was heavily grassed, and being diluted by flow from 70 acres of cropland.

Streamflow water quality

	Barnlot 0.4 acre	Cropped agricultural watershed 75 acres
	Range	Range
BOD	10 to 420 ppm	1 to 40 ppm
Dissolved in water		
Total Nitrogen	10 to 70 ppm	0.7 to 8.3 ppm
Organic-N	5 to 60	.3 to 4.4
Nitrate-N	1 to 15	.2 to 5.8
Ammonium-N	1 to 30	.2 to 3.2
Phosphorus-P	1 to 10	.2 to 1.3
Solids	0.1 to 1.5% of water flow	Too small to evaluate
Concentration of -		
Organic-N	10,000 to 40,000 ppm	- -
Nitrate-N	1 to 150	- -
Ammonium-N	100 to 2,000	- -
Phosphorus-P	300 to 1,200	- -

SOLIDS CARRY LARGE QUANTITIES OF POLLUTANTS.

POLLUTION FROM ANIMAL LOTS CAN BE REDUCED BY --

PASSING FLOW THRU GRASS FILTER STRIPS AND GRASS WATERWAYS ON LOW GRADIENT,

OR USING SETTLING BASINS OR DETENTION STRUCTURES WHERE SOLIDS ARE TRAPPED.

VEGETATION LEACHED

POLLUTION FROM FARM AND WOODLAND INDIRECTLY RELATED TO FARM OPERATIONS -- LEACHED FROM FROZEN AND THAWED VEGETATION

Figure D-1. Snowmelt runoff carries nutrients leached out of frozen and thawed vegetation.

Significant quantities of nitrogenous byproducts are leached out of decaying vegetation by winter-spring rain and melting snow. Freezing ruptures plant cells which release nutrients to runoff from snowmelt or rain --------

PHOSPHORUS	=	0.34 lb/acre from hay 0.01 lb/acre from corn
NITROGEN	=	Often greater losses in snowmelt runoff from frozen and thawed vegetation than in runoff water from storm rainfall

These chemical pollutants from vegetation inputs to the earth's water system contribute a sizable amount of pollution to water.

RAIN WATER SOURCE OF NITROGEN

RAINWATER CLEANS THE ATMOSPHERE,
BUT ADDS CHEMICALS TO THE EARTH'S SURFACE

Figure E-1.-Rainstorm carries pollutants to earth's surface

Some enrichment and pollution of surface waters comes from precipitation. Not all comes from farm operations. At COSHOCTON precipitation brought in:

> 18 pounds of NITROGEN per acre per year which was made up of about:
>
> > 9 pounds per acre as nitrate-nitrogen
> >
> > 9 pounds per acre as ammonium-nitrogen

NITROGEN supplied in precipitation was about FOUR TIMES the amount of nitrogen carried off in STREAMFLOW.